Your local conservation district, the state nutrient management office, and Delaware Cooperative Extension can provide additional nutrient management information.

Delaware Cooperative Extension:
Kent County 302-730-4000
New Castle County 302-831-2506
Sussex County 302-856-7303

Conservation Districts:
Sussex 302-856-3990
Kent 302-741-2600 (ext. 3)
New Castle 302-832-3100 or 834-3560 (ext. 3)

Nutrient Management Program: 1-800-282-8685 or 302-698-4500
University of Delaware Nutrient Manager: 302-856-7303
www.state.de.us/deptagri/nutrients/index.shtml/

Nutrient Best Management Practices

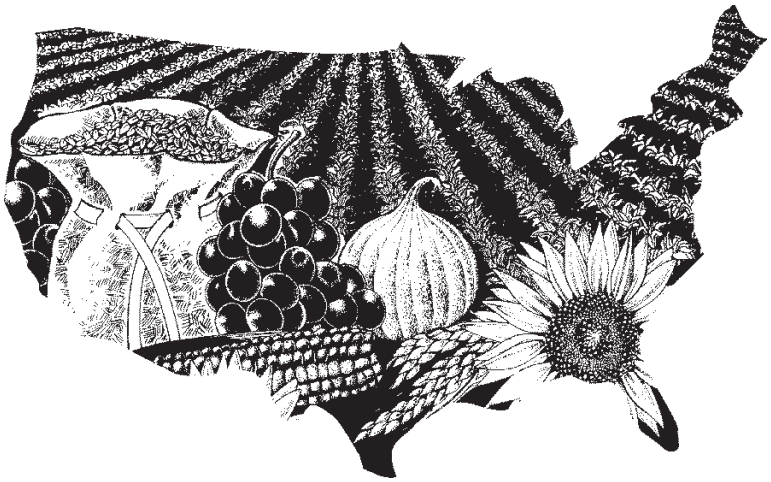
DELAWARE
NUTRIENT
MANAGEMENT

Delaware Department of Agriculture

Best Management Practices

Today's Agriculture:
A Responsible Legacy

Nutrient Best Management Practices



Creation of the Nutrient Best Management Practices booklet is credited to and acknowledges the following:
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Delaware Nutrient Management Commission
Delaware Department of Agriculture
USDA Natural Resources Conservation Service
Delaware Department of Natural Resources and Environmental Control
University of Delaware Cooperative Extension
Delaware Conservation Districts

Approved and paid by the Delaware Nutrient Management Commission

Doc. No. 65-01-25/05/05/05

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BMP IDENTIFICATION FOR TRADITIONAL AGRICULTURE:

1. Feed Related Amendments

Feeding strategies to reduce nutrient excretion in poultry litter and other manure have great potential today and into the future. With the addition of phytase to commercial broiler diets and the refinement of phosphorus requirements, excretion of phosphorus in litter is expected to decrease by more than 30%. As other cost-effective technologies are refined, such as vitamin D derivatives, the reduction of phosphorus in litter may well exceed 50% of today's values in the near future. Combined with more long-term strategies such as the inclusion of feed grains with higher available phosphorus content, the reduction in phosphorus may well be 70% less than litter just a few years ago.

2. Poultry Litter Amendments

Poultry litter amendments are one of several management strategies employed to reduce ammonia and odor emissions from poultry houses. These products can be added to litter, feed or water to chemically or biologically reduce the ammonia volatilization rate from litter. By reducing the ammonia losses from litter, the nitrogen content and value of the litter may be increased. Although the most common acidifying chemical litter amendments offer effective immediate ammonia control, they have limited longevity. Some aluminum, iron and calcium base acidic compounds have the added benefit, when used at rates above that typically required for ammonia control, of binding soluble phosphorus in litter. These products may be particularly beneficial for operations that must limit litter application due to high soil-test phosphorus or where the risk of soluble phosphorus losses from fields are high.

3. Roof Runoff Management in Feedlots

NRCS Practice Code: 588

Roof runoff management in feedlots is a system of components for collecting, controlling and disposing of runoff from roofs that would otherwise enter a feedlot and become contaminated. Components may include, but are not limited to, erosion-resistant channels, subsurface drains with rock filled trenches along building foundations below eves, underground outlets, roof gutters, downspouts and appurtenances.

4. Stormwater Control in Feedlots

Stormwater control in feedlots is a system of components for controlling runoff generated from a feedlot operation. Clean water from roofs and non-contaminated areas of the feedlot operation is kept separate from contaminated runoff leaving the feedlot. Contaminated runoff is to be captured, stored and safely disposed of as outlined in the nutrient management plan. Components may include, but are not limited to, underground outlets, diversions, grassed waterways, waste storage structures, and spray irrigation systems.

MANURE STORAGE

5. Temporary Storage

The most efficient method of handling and storing poultry litter results from handling the poultry litter as few times as possible. Ideally, total cleanouts and crust outs are immediately land applied, transported to an alternative use or to a storage structure. However, timing considerations may require temporary outdoor storage of the litter before use, which must be conducted while implementing best management practices.

In situations where temporary storage is needed litter may be stored temporarily to preserve litter quality and prevent application at the wrong time of the year. Temporary storage is the least preferred storage practice, but may be conducted according to the standards outlined below:

<table>
<tr><th>Production Area Storage</th><th>Non-Production Area Storage Up to 90 Days</th><th>Non-Production Area Storage
Over 90 Days to 150 Days</th></tr>
<tr><td rowspan="3">"Production Area" means that part of an Animal Feeding Operation that includes the animal confinement area, the manure storage area, the raw materials storage area and the waste containment areas, also includes egg washing or processing facility and any area used in the storage, handling, treatment or disposal of mortalities.The Production Area should be defined in the operation's Nutrient Management Plan.</td><td>Temporary Storage away from the "Production Area" can be staged for land application and is limited to 90 days without the use of an impervious cover.</td><td>For conditions that require temporary storage of litter beyond 90 days, individual or general authorization may be granted by the DNMC or Delaware Department of Agriculture for storage up to 150 days. For any storage greater than 150 days, an impervious cover is required.</td></tr>
<tr><td rowspan="2">The following BMPs are required for Non-Production Area Storage Up to 90 days:

1. The pile must be at least 6 feet high and in a conical cross section shape; and
2. Litter shall not consist of more than 5% crust out material; and
3. The selection of the temporary storage site must consider the highest, most practical site possible and shall not use the same site more than once every two years without a storage site that meets NRCS standards or other containment lining standards approved by the DNMC; and
4. The temporary storage sites must be identified in the nutrient management plan; and
5. The site must be located at least 100 feet from a public road, 100 hundred feet from any surface water and 200 feet from any residence not located on the property; and
6. The site must be at least 200 feet from a domestic well and 300 feet from a public water supply well; and
7. Post litter removal treatment must include the removal of all litter and the top 1-2 inches of topsoil if the topsoil is co-mingled with the litter to prevent nutrient loads; and
8. A production crop or cover must be established and maintained at the site as soon as practical following post removal treatment.
9. For temporary storage sites on soils classified as located within 1 ½ feet of the depth to the seasonal high water table, any <u>one</u> of the following practices must be implemented:
a. The establishment of a storage site that meets NRCS standards or other containment lining standards approved by the DNMC; or
b. The use of high carbon (content) material (straw, wood shavings, fodder) as the base of the pile at least 8 inches thick to serve as a barrier and easy post storage removal; or
c. The use of powdered bentonite or similar material that will seal the area under the pile.</td><td rowspan="2">The following BMPs are required for Non-Production Area Storage Over 90 days:

1. The pile is to be constructed as large as possible and be at least 10 feet high and in a conical cross section shape; and
2. Litter shall not consist of more than 5% crust out material; and
3. The selection of the temporary storage site must consider the highest, most practical site possible and shall not use the same site more than once every two years without a storage site that meets NRCS standards or other containment lining standards approved by the DNMC; and
4. The temporary storage sites must be identified in the nutrient management plan; and
5. The site must be located at least 100 feet from a public road, 100 hundred feet from any surface water and 200 feet from any residence not located on the property; and
6. The site must be at least 200 feet from a domestic well and 300 feet from a public water supply well; and
7. Post litter removal treatment must include the removal of all litter and the top 1-2 inches of topsoil if the topsoil is co-mingled with the litter to prevent nutrient loads; and
8. A production crop or cover crop must be established and maintained at the site as soon as practical following post removal treatment; and
9. The establishment and maintenance of a 24-foot vegetative buffer surrounding the pile site.
10. For temporary storage sites on soils classified as located within 1 ½ feet of the depth to the seasonal high water table, any <u>one</u> of the following practices must be implemented:
a. The establishment of a storage site that meets NRCS standards or other containment lining standards approved by the DNMC; or
b. The use of high carbon (content) material (straw, wood shavings, fodder) as the base of the pile at least 8 inches thick to serve as a barrier and easy post storage removal; or
c. The use of powdered bentonite or similar material that will seal the area under the pile.</td></tr>
<tr><td>Temporary storage within the "Production Area" (as defined above) is limited to 14 days without the use of an impervious cover.</td></tr>
<tr><td>The following BMP(s) are required for Production Area Storage:

1. The stockpile must be separated from any channeled runoff, standing water and other drainage systems such as roof runoff and down spouts.

These following additional BMPs are required for Production Area Storage of 2-14 days:

2. The stockpile must be at least 6 feet high; and
3. The stockpile site must meet Natural Resources Conservation Service (NRCS) standard or other containment area lining (standards) approved by the DNMC.</td><td></td></tr>
</table>

6. Pasture Stream Fencing
NRCS Practice Code: 382

Pasture stream fencing is the installation of a suitable permanent structure that acts as a barrier between pastureland and a watercourse with the purpose of excluding livestock from the ditch or stream. The type of livestock using the pasture will determine the type of barrier used. Sheep and hogs may require woven wire fence, horses may require a wooden or non-injurious type of fence, while cattle can be controlled with barbed wire or electric fence. If the livestock depend on the watercourse for their water supply, a new watering facility may be required.

7. Manure Sheds - NRCS Practice Code: 313

A manure shed is a roofed building for stacking dry manure and protecting it from precipitation during the storage period. The shed needs to be large enough to accommodate the equipment delivering and removing the waste. The volume contained within the shed is based on the anticipated volume of manure plus bedding generated during the storage period as defined in the nutrient management plan. Spontaneous combustion of the manure in a shed can be a problem unless the precautions listed in the nutrient management plan are followed.

8. Dry Straw Based Manure Storage
NRCS Practice Code: 313

A dry straw-based storage structure is often called a stacking facility. It may be roofed or unroofed, and usually has sidewalls (or a curb), and a concrete floor. If runoff from the facility will occur, a cover or a system to filter (treat) the runoff or a system to collect and store the runoff will be required. The facility needs to be large enough to accommodate the equipment delivering and removing the waste. The volume contained within the facility is based on the anticipated volume of manure plus bedding generated during the storage period as defined in the nutrient management plan. The manure must contain enough straw to make the mixture stackable, and adsorb excess moisture.

9. Bunkers
NRCS Practice Code: 313

A bunker, while generally not preferred, is a waste stacking facility with a curb or walls, an impervious floor, and typically has no roof. This type of facility is used where the waste material has a large amount of cellulose bedding in it, such as straw, wood chips, or saw dust. This type of facility is not suitable for waste material that has sand bedding, or little or no cellulose bedding. The size of the bunker is based on the anticipated volume of manure plus bedding generated during the storage period as defined in the nutrient management plan. If runoff from the facility will occur, a cover or a system to filter (treat) the runoff or a system to collect and store the runoff will be required.

10. Liquid Manure Handling Systems
NRCS Practice Code: 312

A liquid manure handling system is a planned system in which all the necessary components are in place for collection, transporting, storing and disposing of liquid manure and contaminated runoff in a manner, which does not degrade air, soil, or water resources. Components may include, but are not limited to: debris basins,

dikes, diversions, fencing, grassed waterways, spray irrigation systems, pond sealing or lining, subsurface drains, surface drains, waste storage ponds, waste storage structures, and waste treatment lagoons.

11. Lagoons and Tank Systems

NRCS Practice Code: 359 (lagoon) and 313 (tank)

A lagoon is a waste treatment impoundment made by construction of an embankment and/or excavating a pit or dugout. The purpose of a lagoon is to treat manure and wastewater and thereby reduce pollution potential. An impermeable liner is an essential component of a lagoon. A lagoon can be either aerobic or anaerobic in process, and will have an established minimum and maximum operating level. The size of the lagoon is based on the selected process and the number and type of animals in the operation.

A tank is a storage structure for liquid manure and wastewater. The volume of the tank is based on the anticipated volume of manure and bedding plus wastewater generated during the storage period as defined in the nutrient management plan. Tanks must be impervious and provide for agitation of its contents before emptying because the liquid and solid portions of the waste will separate during the storage period. Remixing of the contents is necessary for the proper removal of the waste material. Sand bedding can be very difficult to remix with the liquid portion of the waste, and will reduce available storage volume when it accumulates in the bottom of the tank.

12. Slurry De-watering Systems

A slurry de-watering system is a planned system with all the components in place for collection, transporting, storing and separating the liquid portion of the waste from the solid portion. Components may include but are not limited to settling tanks, greenhouse type drying facilities, mechanical solids separators, storage sheds, storage tanks, spray irrigation systems and composting facilities.

13. Fertilizer Storage

Various State laws govern the safe handling and storage of inorganic nutrients, or fertilizers. For example, storing large quantities of liquid fertilizers may require construction of a permanent storage facility. The Department of Natural Resources and Environmental Control should be consulted regarding the laws in your area. In general, when storing fertilizers on the farm you should consider proximity to animals or feed storage areas, proximity to water supplies, location and construction of the mixing area, adequate labeling, and security (doors, locks, etc.). Storage areas should be routinely examined for leaks or spills, and to check the function of washing and first aid equipment. Potential problems can be minimized by storing only as much fertilizer as absolutely necessary in secured indoor facilities.

14. Nutrient Management Relocation

Animal Feeding Operations (AFOs) with inadequate land to apply animal waste or farms with high phosphorus, as determined by soil tests from an approved soil laboratory, should relocate nutrients to farms in need of nutrients or to alternative use

projects. Receiving farms need a Nutrient Management Plan to ensure proper application rates and methods. Alternative use projects are active in Delaware and are defined as the use of animal manure other than the application of raw material on land. These projects generally provide a renewable or recyclable product for alternative market places. Cost share funds may be available to assist in the transportation cost of relocating manure.

ANIMAL MORTALITY HANDLING

Daily Mortality:

15. Composters

NRCS Practice Code: 317

A composter is a facility for the biological treatment of the normal daily accumulation of dead animals from an animal feeding operation. The facility usually includes bins in which the carcasses are placed in layers with a carbon source (typically straw, corn cobs, or saw dust), poultry manure (which provides nitrogen and deters scavengers) and a small amount of water in accordance to a recipe which is established in the nutrient management plan. The facility typically includes a roof and a concrete floor. The biological activity that breaks down the organic material generates heat that will sterilize the final product. The material being composted requires one turning during the composting process to assure that contents initially placed near the edge of the bin are moved to the center for proper heating. The size of the composter is based on the number and type of animals to be composted.

16. Rendering for Large Animals

Animal mortality should be disposed of in a way that prevents contamination of surface and ground waters. Burial of large animal mortality should not be considered due to the potential for surface and ground water contamination. While composting is the typical and the preferred process of dealing with non-catastrophic animal mortalities, composting of large animal mortality, such as dairy cows or horses can be difficult due to animal weight and size. In the event of large animal mortality, rendering companies provide pick-up and delivery for a fee.

17. Composting of Large Animals

Composting is an efficient alternative for large animal carcass disposal. During composting, microorganisms create a “slow cook” process that causes the carcass to degrade. For microorganisms to do their job, a proper balance of water, nutrients, carbon, and air will allow the compost process to start and to continue at a rate that produces enough heat to kill pathogens in the compost mix. Sawdust and woodchips are the preferred carbon source because they provide an excellent contact surface for the animal carcass. The carcass should contain enough water to meet the 40- to 60-percent moisture required for composting. A dairy animal buried in sawdust 15 to 18 inches deep on all sides will enable microbes to begin their work. If the Carbon/Nitrogen ratio, moisture, and oxygen are at the proper levels, microorganisms will cause the compost mix to heat to temperatures ranging from 135 to 150°F, a good composting temperature. The compost mix won’t heat properly if it is too dry or too wet. It takes up to six months for composting to degrade a mature dairy cow.

18. Freezer

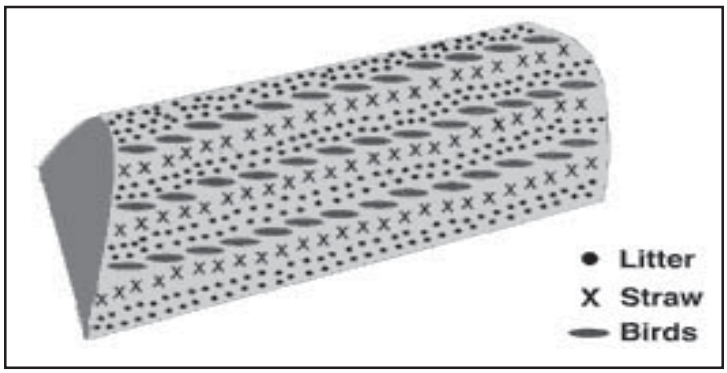
A freezer is a unit capable of freezing and storing animal carcasses until such time as they can be removed offsite for recycling or rendering. The capacity of the freezer is based on the maximum daily weight of animal carcasses produced during a typical growing cycle and the estimated time between emptying events.

19. Incinerators (Ash disposal plan required)
NRCS Practice Code: 769

An incinerator is a device used to dispose of mortalities from a poultry-feeding operation by combustion. An incinerator requires an ash disposal plan. The ash disposal plan typically requires the use of an ash collection box or bucket, and disposal by land application on cropland or through a community trash disposal system. The capacity of an incinerator is based on the maximum daily weight of animal carcasses produced during a typical growing cycle. All incinerators must be registered with DNREC. Under current DNREC policy, only double-chambered incinerators with a burner in each chamber are approved for use in Delaware.

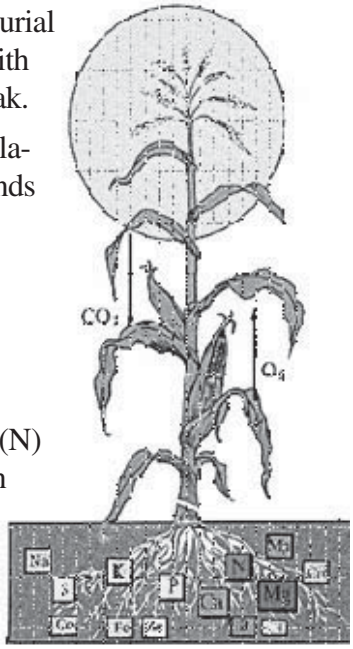
Catastrophic Animal Mortality:

20. Composting Catastrophic Mortality of Poultry



The Delaware Nutrient Management Commission has identified composting as the preferred method of disposing of catastrophic mortality of poultry and other animals. Composting occurs when organic materials, such as dead birds, go through rapid decomposition in the presence of oxygen, water, and an adequate carbon source. Constructing a "wind row" composting pile can accommodate large quantities of poultry mortality. These piles are approximately 12 feet wide and 6 feet high. In these dimensions, the piles contain approximately 300 pounds of mortality per linear foot. Specific guidelines for constructing wind-row composting piles are available at http://www.agnr.umd.edu/MCE/Publications/PDFS/FS717.pdf

Alternatives to composting may be disposal of dead animals in a sanitary landfill. Additionally, in the event of a very serious, extremely communicable disease, mass burial on the infected premise may be conducted as agreed upon by State Agricultural and Environmental officials. In general, burial setbacks include distance from a well, stream, dwelling, animal facilities, roadways and seasonable ground-water table. Burial for catastrophic events is the least preferred method for disposal and must be conducted with the highest biosecure methods available in order to prevent a communicable disease outbreak.



For dead animals of several hundred pounds, the pathogenic incinerator at the Delaware Department of Agriculture may be used. Capacity of this incinerator is 200-300 pounds per hour.

ANALYSIS AND TESTING:

21. Pre Side-dress Soil Nitrate Test (PSNT)

The PSNT is an in-season tool to help corn producers optimize their nitrogen (N) management. The idea of the PSNT is that a soil test, taken at the appropriate time, can provide information on the N status of a cornfield and allow the farmer to make necessary side-dress applications of N if necessary. Soil samples are collected when corn plants are 6-12 inches tall (ideally 10-12 inches) at the whorl. A "sample" is a collection of at least 15, 12-inch cores and should represent an area of similar soil type and management history not

to exceed 20 acres. Laboratory analysis of the soil sample will reveal the amounts of readily available nitrate-N (NO_3^-) in the soil, and tables provided by Delaware Cooperative Extension can then be used to calculate necessary additions of N.

22. Soil Test

Soil testing is an integral part of any nutrient management program because it is the only way to reliably assess the soil's contribution to plant nutrient requirements. Two of the most important elements of soil testing are determining the size of the area to be sampled and the number of samples to be collected. Samples should be collected to represent an area no larger than 20 acres, if possible. Each soil sample should consist of a minimum of 15 cores to minimize the impact of a single abnormal core. Samples should be collected from the appropriate depth, for most elements this depth is 6-8 inches. Soil testing involves not only the collection of samples, but also interpretation of laboratory results. University of Delaware Cooperative Extension has information available to aid operators in making management decisions based on soil test results for phosphorus (P), potassium (K), and many other nutrients. Although the Nutrient Management Law requires soil samples used with a nutrient management plan to be no older than three (3) years, more frequent testing will promote better nutrient management.

23. Phosphorus Site Index

The Phosphorus Site Index (PSI) s a field-rating system designed to assess the relative risk of phosphorus movement from fields to ground or surface waters. The PSI assesses this risk by considering site-specific information such as soil types, landforms, and management practices. This information allows managers to focus Best Management Practices (BMPs) in areas of highest environment concern. Environmental concerns with phosphorus center around eutrophication, defined as "*an increase in the fertility status of natural waters that causes accelerated growth of algae or water plants*".

24. Phosphorus Saturation Ratio

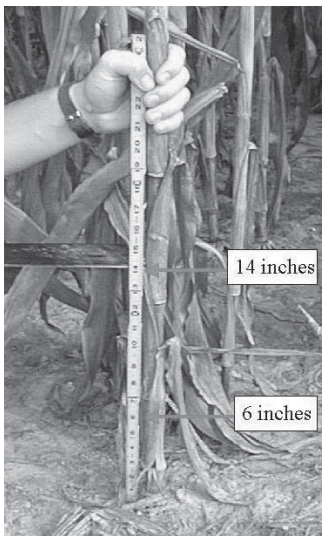
The Phosphorus Saturation Ratio (PSR) is an indicator of the ability of the soil to retain phosphorus (P). This ability is measured by the ratio of extractable P to iron and aluminum available to tie up that P. As the ratio increases (soils become more saturated with P), the quantity of P that can be lost from the soil by erosion, surface runoff, and leaching increases. Research has shown that an increase in P loss occurs at PSR levels above approximately 20%. The PSR is included in soil test reports generated by the University of Delaware soil testing lab.

25. Tissue Analysis

Tissue testing is a valuable tool for in-season assessment of the availability of a number of essential plant elements. Such assessments are an important part of any nutrient management program. Some common elements determined in routine plant analysis include nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg), and sulfur (S). As with soil testing, the collection, handling, and analysis of plant samples must be done properly to obtain useful results. University of Delaware Cooperative Extension has information available to aid operators in making management decisions based on tissue test results.

26. Stalk Nitrate Test on Corn

The end-of-season corn stalk nitrate test is a simple, inexpensive tool that can be used to assess the nitrogen (N) status of a corn crop at the end of the growing season. This test makes use of the fact that corn plants either remove N from, or accumulate N in, the lower stalk based on soil N availability. Studies over a wide range of conditions have found remarkably similar relationships between the amount of N found in the lower stalks late in the growing seasons and the likelihood that corn had been under or over-fertilized. Plant samples are collected after the corn is mature, usually 2 weeks after "black layering." University of Delaware Cooperative Extension has a publication; "End-of-Season Corn Stalk Nitrate Testing to Optimize Nitrogen Management" to aid operators in interpreting the results of their cornstalk tests.



27. Manure Testing

Manure testing is an integral part of any nutrient management program because animal manures vary widely in their nutrient composition. The four most common elements of manure testing are determining moisture, nitrogen (N), phosphorus (P) and potassium (K) content. There may also be situations where micronutrient or metal contents are critical. Delaware Cooperative Extension recommends that manure samples be collected for the smallest "unit" practical because of potential for enormous variability between different loads, manure types, etc. University of Delaware Cooperative Extension has information available to aid operators in collection and handling of manure samples. When sampling in the poultry house, take about 15 cores with a probe or shovel from random locations throughout the house making sure you sample the full depth of the litter and avoid the dirt floor. When sampling a stockpile, take about 10 scoops from the pile making sure that you penetrate as deep as possible into the pile. Do NOT include the wet, crusted outside layer of the pile in your sample. Place all 10 to 15 scoops or cores into a bucket and mix them thoroughly and then take a subsample and place in a one-gallon ziplock bag and seal. Leave space in the ziplock bag for gas expansion. Keep samples cool until delivery to the laboratory.

ADDITIONAL BMPs

28. Vegetable Waste (non permitted) Disposal

Vegetable production generates waste by-products that have the potential to contribute nutrients. These by-products should be managed in a manner that prevents nutrient contamination to surface and ground waters. Consideration should be given to the amount of raw waste generated, the nutrient content of the waste product, and recognition that nutrient loading depends on the way in which the waste is handled after harvest. Most vegetable waste, such as sweet corn fodder, cull ears and husks should be provided as a green manure recycled and applied to production fields. In the case of interim storage in any location other than a roofed and permanent structure, set back and time limits (14 days) associated with manure storage will also pertain to storing vegetable waste. Proper management of vegetable waste represents an efficient use of nutrients that are available for capture by future crops or cover crops.

29. Soil Structure Management

Soil "structure" refers to the way soil particles such as sand, silt, clay, and organic matter are arranged or "held together." Maintaining good soil structure is extremely important, and the single biggest threat to structure is compaction. Compaction is most commonly caused by animals or equipment and is essentially a "crushing" of the soil. This crushing eliminates pore spaces that are critical for water infiltration, water-holding capacity, and proper root development; each of which can severely limit yields. Compaction can be controlled by following some basic guidelines: avoiding wet fields, using rotational grazing, reduced tillage, deep tillage or ripping, and using certain crop rotations. (Refer to extension, etc. for more information.)

30. Manure Incorporation

Incorporation of surface-applied animal manures is an important practice for both economic and environmental reasons. Manure spread on the surface and not worked into the soil may lose most of the volatile nitrogen compounds as ammonia gas to the atmosphere. This lost nitrogen is not available for plant growth, and has been identified as a possible air quality contaminant contributing to acid rain. Whenever manure is spread, it should be incorporated within two days after spreading.

31. Daily Spreading of Animal Manures

Daily spreading of animal manures is generally not recommended. However, in situations where the operation MUST haul on a daily or very frequent basis, the following guidelines should be considered to minimize odors and environmental threats, and maximize the utilization of manure nutrients. Spreading during cooler, less-humid portions of the day, considering wind speed and direction in relation to neighboring farms or homes, and establishing buffer or "no-apply" zones near roads and residences, will help to minimize odor problems. Immediate incorporation will reduce odors, prevent physical movement of manure to waterways, and conserve valuable nitrogen.

32. Timing of Manure Application

Applying manure at the correct time is important to ensure efficient and cost effective use of nutrients. Timely application of manures is also important to avoid adding nutrients to the waterways of the state. Applications of manure at times when crops will not be available to utilize the nutrients should be avoided. Application of manures should be done as close as possible to the time when the crop is seeded. Spreading manure on frozen ground, snow covered ground or saturated soil should be avoided.

Application of nutrients during favorable weather conditions can reduce the potential for nutrient losses from runoff and leaching. In order to allow for timely incorporation of manures, spreading of manure should not be done if a heavy rain is forecast for the following two days. The efficient use of nutrients means selecting the appropriate rate of each nutrient and applying each in a uniform and timely manner.

The application method and timing is critical to proper nutrient management.

33. Nutrient Application Equipment Calibration and Adjustment

The efficient use of nutrients means selecting the appropriate rate of each nutrient and applying each in a uniform and timely manner. Application of nutrients during favorable weather conditions can reduce the potential for nutrient losses from runoff or leaching.

34. Calibrating Poultry Litter Spreaders

To be an effective source of crop nutrients, poultry litter should be applied evenly and at known rates. Dry litter is commonly applied with a spinner-type spreader. This equipment allows for both even application and a considerable range in application rates. Wet manure, such as that found in breeder or layer operations, is more commonly applied with "flail-type" spreaders. For all types of application equipment the basic procedure for calibrating is to collect litter on tarps that can be weighed in the field. When used properly, this method provides information on both the rate of application and the uniformity of coverage. An excellent step-by-step reference for calibrating manure spreaders can be found at *http://www.usr.sonet.net/usr/ke4rop/litter/index.htm*.

35. Precision Farming

Precision farming or site-specific management utilizes several technologies with a goal of increasing operating efficiencies such as boosting yields, reducing input costs, and improving profit margins. Technologies such as geographic information systems (GIS), automated machine guidance, in-field remote sensing, mobile computing, telecommunications, and advanced information processing when linked with the Global Positioning System (GPS) provide potential improvements to farm practices.

36. Residue Management

Residue Management is the management of the amount, orientation, and distribution of crop and other plant residue on the ground surface year round. Residue management improves water quality, while reducing soil erosion, increasing infiltration, increasing organic matter, improving soil structure, and reducing compaction and crusting.

37. No-till and Strip Till

NRCS Practice Code: 329A

The uniformly distributed crop residues are left undisturbed from harvest to planting. Planting or drilling is accomplished in a narrow seedbed or slot created by coulters, row cleaners, disc openers, in-row chisels or roto-tillers. Weed control is accomplished primarily with herbicides. Cultivation may be used for emergency weed control.

38. Mulch Tillage

NRCS Practice Code: 329B

The soil is disturbed prior to planting. Tillage tools such as chisels, field cultivators, discs, sweeps or blades are used. Weed control is accomplished with herbicides and/or cultivation.

39. Ridge Tillage

NRCS Practice Code: 329C

The crop residues are left undisturbed from harvest to planting. Planting is completed in a seed bed prepared on ridges with sweeps, disc openers, coulters, or row cleaners. Residue is left on the surface between ridges. Weed control is accomplished with herbicides and/or cultivation. Ridges are rebuilt during cultivation.

40. Seasonal

NRCS Practice Code: 344

The practice of managing the amount, orientation, and distribution of crop and other plant residues on the soil surface during part of the year, while growing crops in a clean tilled seedbed reduces erosion and improves water quality.

41. Cover Crops

A cover crop is any crop planted in a field to provide protection to the soil during a period when row crops are not being grown. Cover crops reduce erosion, scavenge nitrogen that can be utilized by subsequent crops and minimize nitrate leaching into the ground water. Because manures contain nutrient compounds that break down slowly, cover crops should be utilized for all fields where manure has been applied. This period of utilization can be a relatively short time such as a couple of months between spring and fall crops, or a longer time such as six months between fall harvest and spring planting. Which type of cover crop is best depends on many factors including crop rotation and management goals. For example, is the goal simply to reduce erosion, scavenge nitrogen, put nitrogen back into the soil (i.e., legumes), or a combination of these and other objectives? During winter, recommended grass species include cereal rye, wheat, and barley although any winter-hardy annual species can be

used. Broadleaf species that can be used include winter rape and other leafy Brassica crops. Legume cover crops such as hairy vetch and annual or perennial clovers can be grown to reduce erosion. However, these species are not efficient for scavenging nitrogen from previous crops. During summer, grasses such a sudangrass, sorghum-sudangrass hybrids and others can be effective in protecting soil and trapping nutrients. Non-grasses such as buckwheat also can be effective cover crops. To maximize cover crop benefit, plant as early as possible, optimize soil-to-seed contact, and plant at the upper end of the suggested seeding rate range. The cover crop should be maintained as late into the spring as practical without running the risk that it will deplete sub- and topsoil moisture levels to the point of being injurious to the next crop.

42. Vetch Cover Crop

Hairy vetch is the most efficient nitrogen-fixing legume often fixing 50 to 100 or more pounds N/acre, dependant upon planting date and plant life. Nitrogen is released to the next crop rapidly.

43. Scarlet Clover Cover Crop

Scarlet clover, also referred to as crimson clover, is not as effective as hairy vetch at fixing N but will fix 60 to 90 or more lbs N/A plus increase availability to the next crop of other nutrients such as P and the micronutrients. Nitrogen release is also rapid.

44. Cereal Grain Cover Crop

Cereal grains planted solely as cover crops and other crops used as cover should be monitored closely in the spring to prevent excessive soil moisture loss in seasons with below average winter or spring rainfall. If adequate rainfall is received, time the destruction of the cover crop by tillage, herbicide, or other mechanical crop injury and destruction with the cover crop's growth stage and the subsequent crop's growth so nitrogen and other nutrients will be mobilized at a time suitable for crop uptake.

45. Legume Cover Crop

Many legume cover crops release nitrogen very rapidly after incorporation or destruction. To slow this release, include cereal rye, winter oats, or other high carbon winter crop when seeding the legume.

Legumes are appropriate cover crops for fixing atmospheric nitrogen for subsequent grass crops. Legumes can help make phosphorus and micronutrients more available to subsequent grain crops.

46. Conservation Buffer

Conservation buffers are areas or strips of land maintained in permanent vegetation to help improve water quality. The vegetation can be cool season grasses, warm season grasses, and/or trees and shrubs. Buffers can trap sediments, take up nutrients, provide valuable wildlife habitat, and provide shading of the stream. The size of the buffer depends on the intended use of the buffer. The minimum width should be 10 feet for limited sediment entrapment with a preferred minimum width of 24 feet, while the minimum width for a wildlife buffer is 35 feet.

47. Riparian Forest Buffer

NRCS Practice Code: 391

Riparian forest buffers are an area of trees and/or shrubs located adjacent to and up gradient from water bodies.

48. Vegetative Filter Strips
NRCS Practice Code: 393

A filter strip is a strip or area of herbaceous vegetation situated between cropland, grazing land or disturbed land (including forestland), and environmentally sensitive areas.

49. Water Control Structure
NRCS Practice Code: 587

A water control structure is a device that conveys water, controls the direction or rate of flow or maintains a desired water surface elevation. These are typically used to control the depth and discharge of water in open channels, ponds, and wetlands. They can also be used for water quality control, such as sediment reduction and temperature regulation.

50. Drainage Ditch Maintenance

Well managed and adequately vegetated drainage ditches are important to ensure the productivity of agricultural land as well as their potential for environmental impact. The unintended direct application of manure or nutrients into or in proximity to drainage ditches can greatly affect Stormwater discharges of those nutrients into Waters of the State. Nutrient applications should not be conducted along ditches, ditch side-slopes, maintenance right of ways, tilled land or any other land immediately adjacent to the ditch. The potential to discharge nutrient-bearing stormwater into ditches must be prevented by employing protective nutrient application setbacks or incorporation into cultivated land. Other BMPs such as vegetative filter strips, planted riparian buffers, constructed wetlands that collect runoff, are important in filtering nutrient runoff before it enters ditches and other water bodies.

Filters such as vegetative buffers are effective along ditch edges and within the ditch and can be planted with approved warm and cool season grasses or lay fallow. Vegetative areas should be maintained through the usage of mowing according to a conservation plan and or a “weed wiper bar” system to control woody plants while preserving the vegetative ground cover. This ground cover is ideal for nutrient uptake and promotes a diverse wildlife habitat. One sided ditch maintenance is common and provides shade for the ditch, which decreases water temperature and provides water quality improvements as well as valuable wildlife habitat. Dipping out a channel to remove accumulated sediment should be considered when appropriate. Strategically placing sediment traps within channels can prolong the over-all dip-out frequency. Your County Conservation District may provide programs to assist in managing drainage ditches for effective drainage and water quality.

51. Strategically Placed Wetland
NRCS Practice Code: 656

A strategically placed wetland is a constructed shallow water ecosystem designed to simulate natural wetlands, and placed in a location that will receive runoff from farmsteads and crop fields. It is designed to control storm water runoff and is effective in utilizing excess nitrogen. This practice is not intended to treat animal waste or runoff from feedlots. Strategically placed wetlands shall be located outside the limits of wetlands of any classification. Components may include inlet screening device to prevent debris from entering the wetland; embankments; overflow structure to maintain proper water level, and control flow from the wetland; and wetland plants. The wetland must be sized to contain the design storm and bypass larger events, while providing the needed detention time for treatment of the target contaminant. All federal, state, and local laws, rules and regulations governing the discharge to waters of the state must be complied with.

52. Strategically Placed Sediment Removal

NRCS Practice Code: 638 (Water and Sediment Control Basin)

Strategically placed sediment removal is a short embankment or a combination ridge and channel typically constructed across the slope and minor watercourses. They are used to trap and collect sediment, reduce on-site erosion, reduce the sediment content of runoff, reduce peak rate of flow at down-slope locations, reduce flooding and reduce gully erosion.

53. Grass Waterways

NRCS Practice Code: 412

A grassed waterway is a natural or constructed swale, shaped or graded and established in suitable vegetation for the safe conveyance of runoff. Grassed waterways are used to transport surface runoff from terraces, diversions, or natural concentrations without causing erosion or flooding and thereby protecting or improving water quality. The size and shape of the grassed waterway will be based on the anticipated flow rate and the slope of the waterway and the type and height of the vegetation.

54. General Erosion Controls

NRCS Practice Codes: 350, 362. 393, 561, 600

Erosion controls are a combination of practices that are constructed or installed with the purpose of preventing or minimizing the loss of soil from a farmstead and cropland. Components may include sediment basins (350); diversions (362), filter strips (393), heavy use area protection (361), and terraces (600). Diversions are used to divert clean runoff away from areas that are susceptible to erosion. Terraces are used to shorten the slope length in a crop field. Filter strips are grassed areas placed across the slope below cropland or farmsteads for the purpose of catching and trapping soil particles in the runoff as it passes through. Heavy use area protection consists of covering the soil in an area that gets heavy use, such as farmsteads and farm lanes with a surface that will protect the underlying soil from erosion. Typically gravel, concrete or asphalt is used. Sediment basins are used to trap sediment once erosion has occurred, and prevent its transport offsite.

55. Field Windbreak for Erosion and Odor Control

NRCS Practice Code: 394

A strip of trees or shrubs established adjacent to a building, feedlot, or field to reduce erosion, conserve energy, control snow deposition, prevent wind damage, provide shelter for livestock, improve water quality, reduce noise pollution, provide wildlife habitat, and improve landscaping.

The major benefits of trees around the perimeters of buildings include increasing production efficiency, demonstrating proactive environmental stewardship and fostering good neighbor relations. Properly established windbreaks can reduce heating and cooling costs, minimize structural damages from wind and prevent air-borne diseases from entering and exiting your farm. Planting trees around farms also offers environmental benefits and represents good stewardship. Another important aspect of trees is their ability to filter odor and noise, thus decreasing the likelihood of odor and noise-related complaints from neighbors.

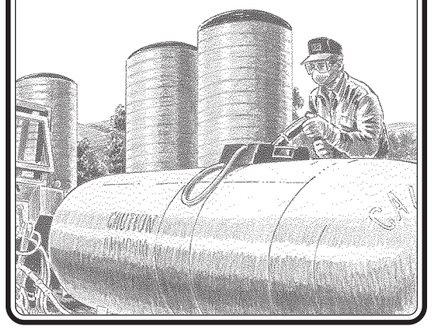
56. Irrigation Systems and Education

Irrigation can be a great benefit to nutrient management planning. It helps normalize yields during periods of dry weather. When a consistent supply of water is provided, plants can utilize the nutrients that are available.

This in turn reduces the amount of residual nutrients and lessens the likelihood of leaching into the ground water.

Your local conservation district, the state nutrient management office, and Delaware Cooperative Extension provide additional nutrient management information.

The Delaware Nutrient Management Commission is charged to establish and encourage implementation of Best Management Practices (BMP) in generation, handling or land application of nutrients to protect water quality while maintaining agricultural profitability.



"Water Quality is Everyone's Responsibility"